Chapter V: Engineers Improve The Ohio River, 1827-1841

The failure of John Bruce to satisfactorily complete his contract in 1827 clearly indicated the project for clearing the rivers of snags would require continuous efforts. The success of the experimental wingdam near Henderson, Kentucky, also indicated that similar improvements might be accomplished at other obstructive bars on the Ohio. The Corps of Engineers terminated the Bruce contract in 1827, employed Captain Henry Shreve as Superintendent of Western River Improvements, and authorized construction of the necessary floating plant and employment of a hired labor force to continue the project.

Because of the somewhat different requirements of navigation on the Ohio River above and below the Falls, a separate project for the improvement of the Upper Ohio was authorized in 1835. Captain Shreve retained charge of improving the lower river and Captain John Sanders, Corps of Engineers, was appointed as superintendent of the Upper Ohio project. Their operations consisted chiefly of implementing three different but related improvement methods: removings snags and similar obstructions which were the most immediate threat to waterways safety, blasting away rocks to clear tortuous boulder-strewn channels, and constructing simple stone riprap dikes to concentrate water flow over bars and scour away accumulated sand and gravel deposits. In performing these operations, Captain Shreve, Captain Sanders, and their associates developed several novel waterways engineering methods which were still utilized by the Corps of Engineers in the twentieth century.

Rivers and Harbors Act of 1827

A steamboat boom and an increasing flatboat traffic transported a burgeoning commerce in the Ohio Valley in the 1820s. Steamboat tonnage on the Ohio and Mississippi river systems in 1827 aggregated 25,700 tons, and about 7,000 flatboats of forty-tons capacity each also were navigating the rivers. Approximately 537,000 tons of freight valued at over fifty million dollars were transported on the Ohio-Mississippi waterway in 1827. But nineteen steamboats were lost, chiefly by striking snags, on the rivers in 1827, and about thirty flatboats and their cargoes, valued at $72,000, went down in the same year. A number of Kentuckians sent a petition to Congress requesting further appropriations for improving the Ohio River navigation. The petition declared:

> That they are situated on the Ohio River, one of the chief tributaries of the Mississippi river, some fifteen hundred miles from New Orleans, the great market and depot of all their produce and manufactures, as well as that of the neighboring States situated upon the same river and its tributaries, for more than one thousand miles above us; and all are compelled to send the effects of their labor down the Ohio and Mississippi rivers to market, in the various craft that usually navigate those streams; that these great and navigable rivers are, in many places, obstructed with trees, stumps, and roots of trees, technically called snags, planters, and sawyers, whereby the navigation of them is retarded and rendered very hazardous; and, by them, many of the various craft on the rivers, with valuable cargoes, are annually lost, to the great injury and distress of the adventurers, who frequently embark on board of them, with the effects of their year's labor, and often their all, as well as endangering the lives of the men sailing said craft . . . .[1]

On March 3, 1827, Congress appropriated $30,000 for a continued project for snag removal and for the deepening of the channel of the Ohio at the Grand Chain. It was the first of a series of twelve annual appropriations, averaging $50,000 per

annum and totaling $620,000, made from 1827 through 1838 for the improvement of navigation on the Ohio and Mississippi rivers. These appropriations were applied to the removal of snags and other hazardous obstructions and to the improvement of the Grand Chain. Separate appropriations were also made for the construction of wing-dams, or dikes, on the Ohio and for a project for the improvement of the Upper Ohio River above the Falls.[2]

Snag Clearance Continues

It will be recalled that Captain Henry M. Shreve of Louisville was appointed, December 10, 1826, to succeed Samuel McKee as inspector of the Bruce contract, and the contract was terminated on April 9, 1827, after an unfavorable report by Captain Shreve. Captain Shreve, appointed Superintendent of Western River Improvements at a salary of $3,000 per annum, continued the clearance of snags and other obstructions from the Lower Ohio and Mississippi rivers with crews of workmen using hand tools and the Bruce machine boats. By the end of 1827 Captain Shreve had cleared the Ohio to its mouth and had worked down the Mississippi to the mouth of the White River, progressing at a rate of about six miles per workday. But he found the work "extremely laborious and somewhat hazardous." Each time a machine boat raised a snag from the river bottom, it was swept off downstream by the current. Shreve turned his attention to the development of an improved machine for raising snags and also concluded that, unless the banks of the rivers were cleared of trees, every succeeding high water would leave the river channels littered with new obstructions.[3]

The Grand Chain Project

As Superintendent of Western River Improvements, Captain Shreve was directed to plan a project for the improvement of the Grand Chain of Rocks near the mouth of the river. In support of a specific appropriation for a project at the Grand Chain of Rocks, Congressman Robert P. Henry declared the obstruction "occasioned a greater number of wrecks and the loss of a larger amount of property, than any other on that river." The improvement of navigation at the Grand Chain, he contended, was of great interest to all the states whose commerce was served by the Ohio. The Grand Chain was so hazardous that navigators often employed special pilots to take their vessels through; and, in the early days, a gang of robbers, known as the "boatwreckers," posed as Grand Chain pilots to victimize immigrants and unwary flatboat owners.[4]

Captain Shreve studied the Grand Chain and proposed a channel excavation project. His report explained:

> The Chain is about two miles long, extending from fort [Cantonment] Wilkinson down to the Cedar tree, marked on the sketch. The proper time to commence operations on this part of the river would be about the 1st of August; and the necessary preparation for carrying on the work, will be four twin flat-boats, with machinery to raise and carry off the rocks; sledges, crow-bars, blacksmith tools to keep the drills in order; drills for drilling rock, powder, boxes of tin, otherwise canisters ready made for blasting under water, three flat-boats for quarters and store rooms, and subsistence, the whole sufficient to work from sixty to one hundred men.[5]

Shreve warned the date of completion of the project would be uncertain because sickness among the workmen could be expected, recommended that buoys be placed at the head of the Chain for the guidance of navigators, and estimated costs of the project at about $20,000. General Macomb, Chief Engineer, appointed William Courtney of Pittsburgh, who had

formerly been engaged in the improvement of the Upper Ohio for the state of Pennsylvania, to supervision of the Grand Chain project on May 14, 1827. The General informed Shreve and Courtney that: "As this subject [Grand Chain] is one which has excited much interest among those interested in the navigation of the western waters, it is very desirable that a beneficial result be obtained at an early period . . . ." William Courtney was directed to collect equipment and floating plant at Pittsburgh, employ laborers, and descend the Ohio to the Grand Chain, removing snags left by John Bruce, or which had accumulated after the work of Bruce.[6]

During the working seasons of 1829 and 1830 a channel was blasted through the boulders at Grand Chain, some of which were about forty feet long by twenty wide. Some 3375 tons of rock were removed and placed in a wing dam extending from the Illinois shore to direct more water into the channel. The Grand Chain project was completed on November 5, 1830, and increased the available navigable depth through the channel to forty-eight inches — formerly only twenty-two inches had been available at extreme low water. Buoys were installed at the head of the Grand Chain to mark the channel; they were doubtless the first installed for the benefit of navigation on the Ohio and Mississippi river systems. The Secretary of War reported the success of the Grand Chain project to Congress, recommended that appropriations be made for channel excavation and wing-dam construction at other Ohio River shoals, and declared:

> At present the imports to the west are mainly through these rivers, and the export trade almost entirely. Usually for six months in the year one of these [Ohio] ceases to be useful, because of the numerous obstructions and consequent hazards which are presented at those times when the waters are materially reduced. The inconvenience and risk thus felt are susceptible of such easy remedy and at so small an expense, that it becomes a matter of surprise that improvements so important and valuable to a large community should have been so long overlooked or neglected.[7]

Uncle Sam's Toothpullers

While the project at Grand Chain was underway, Captain Shreve planned and built the first steam-powered snag-boat, or the first, as rivermen often called them, of "Uncle Sam's Toothpullers." Such engineers as Major Stephen H. Long, Captain Richard Delafield, and John L. Sullivan had submitted plans for a number of machines designed to utilize the power of steamboats for snag removal to the War Department in 1824, but they had not been adopted. Captain Shreve built a model of a steam-powered snag-boat in 1824, but, though the Corps of Engineers was interested in the invention and offered to "cheerfully defray" the costs of sending it to Washington for testing, Shreve evidently did not enter the contest. Shreve quickly learned that the Bruce machine boat was inadequate for the task, and he concluded that some more efficient method of snag removal was imperative.[8]

Captain Shreve had driving energy, was physically strong, and was possessed of a resolute will, but he was also somewhat reserved, rather eccentric, and short-tempered. His rugged life as a keelboatman and steamboat captain had ill-prepared him for the routine paper work and accounting which the supervision of government projects and disbursement of government funds entailed. He had labor crews — seven contingents in 1830 — working on the Ohio and Mississippi, and he traveled from camp to camp, not often spending much time at his Louisville headquarters completing reports and balancing accounts. He responded to a re-

quest from the Office of the Chief Engineer for more regular reports in 1829 that the department would have to make allowance for the character of his operations:

> Each individual who has preceded me in the Superintendency of this work has been disgraced. For myself I undertook it with some confidence of success, but with little prospect of credit to myself. My whole time has been devoted to the service, my Machines for doing the work (which on examination will be found to be entirely new invention well calculated for the execution of that work) have all been furnished from the exertions of my own mind. I have always hoped that I should be able to satisfy my Government and go through with that improvement without fault; how that may terminate time has to test.[9]

Rather than follow the proper channel through the Office of the Chief Engineer and the War Department, the impatient Captain Shreve went directly to members of Congress. In a letter to Congressman Charles A. Wickliffe of Kentucky in 1827, he asked the Congressman and his "Western friends" to obtain further appropriations for continuation of the improvement project on the Ohio and Mississippi and for the construction of a steam-powered snag-boat. Shreve explained: "I am induced to believe that a steam boat can be so constructed as to remove every description of obstructions from the bed of the river, at less than one half the expense that the object can be accomplished in any other possible manner . . . ."[10]

When Captain Shreve submitted his plans for a steam snag-boat to the Office of the Chief Engineer in late 1827, General Macomb, after review, informed Shreve that there was no doubt of the "superior efficacy" of the steam snag-boat, but construction of such a vessel would be expensive and cost estimates were requested. After receipt of the estimates, the Chief Engineer recommended that the Secretary of War authorize construction of a prototype for experimental purposes, and two days later, on June 27, 1828, authorization was granted and funds immediately forwarded to Captain Shreve.[11]

Shreve directed the construction of a prototype, at costs of $26,424.71, at the Zelore & Hines Shipyard of New Albany, Indiana, during the fall and winter of 1828-1829. It was launched on April 28, 1829, rated at 336 tons and drawing six feet of water. Captain Shreve named the vessel the *Heliopolis* for reasons now obscure. It was perhaps named for the ancient Egyptian town of Heliopolis in the Nile Delta, or could possible be loosely translated as "Crescent City" — New Orleans.

The *Heliopolis* was actually two steamboats with hulls, each one hundred feet long and twelve feet wide, spaced ten feet apart and connected with strong timbers. A timber bulkhead, covered with quarter-inch sheet iron, was mounted between the two hulls near their bows at the waterline. This bulkhead, commonly known as a "snag-beam," was the principle innovation in the design of the boat. Similar vessels had been suggested by other engineers, but they proposed to raise snags with steam-powered windlasses mounted between the hulls. The *Heliopolis* was designed to ram snags head-on, thus bringing to bear the weight of the boat, the power of the engines, and the force of the current to smash snags loose from the riverbed. Snags were then to be raised between the hulls with windlasses and sawed into chunks for use in firing the boilers or other convenient disposal.[12]

Captain Shreve steamed the *Heliopolis* down river at the beginning of the low-water season of 1829, picked up a working crew at Grand Chain, and proceeded to Plum Point, the most snag-infested section of the Mississippi, and began ram-

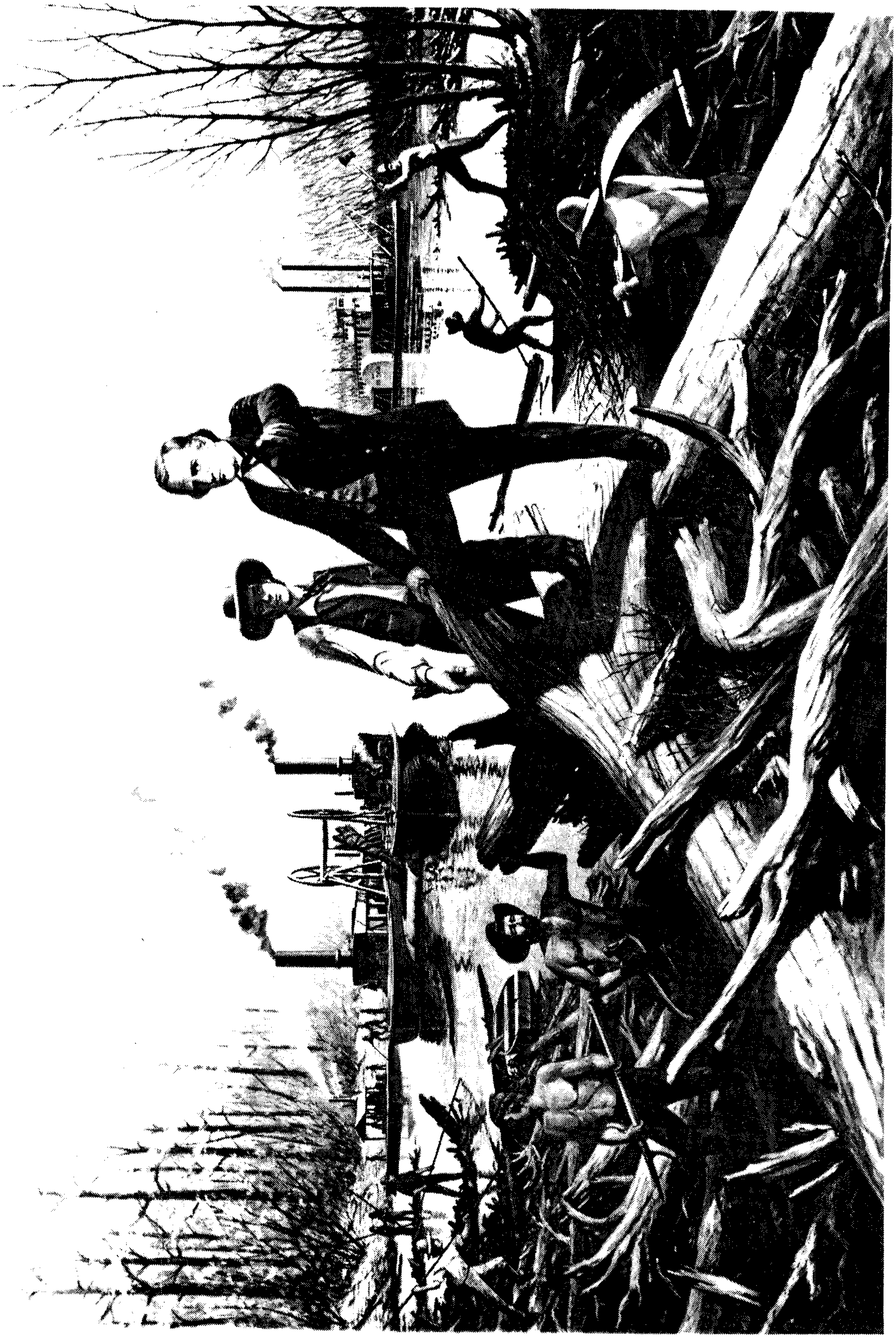
ming snags out of the river on August 19. He reported that after eleven hours work, all snags on that river section were broken off several feet below the surface of the sand at the bottom of the river, and the vessel had exceeded his "most sanguine expectations." An officer of the Corps of Engineers who later inspected the *Heliopolis* was equally enthusiastic:

> No machine can surpass it in its adaptation to the work in the execution of which it is now engaged. The machine is simple in its construction and easy in its application, while in power it has been found adequate to overcome promptly every obstacle it has yet encountered. Through the agency of this machine the largest snags and logs are extracted with ease, many of which, without its intervention, could never have been removed. The value of such an auxiliary . . . cannot be properly estimated, except by comparing its performance with the tardy and expensive mode of removing snags and logs before its invention.[13]

The *Helioplolis* removed 2,061 snags during the first season and was so successful that merchants and steamboat masters of Louisville petitioned Congress for the construction of similar vessels. General Charles Gratiot, Chief Engineer (1828-1838), agreed, and other snag-boats were authorized. The *Archimedes,* a smaller snag-boat, designed to draw less than four feet of water and constructed for about $12,000 less than the *Heliopolis,* was completed in 1830 at New Albany and joined the first "toothpuller" in clearing the rivers. Six steam snag-boats were constructed while Captain Shreve was in charge of western river improvements. The *Heliopolis* wore out and was replaced with a second boat of the same name; the *Archimedes,* in what must have been an embarrassing moment for Captain Shreve, stove itself while raising a snag in 1836, and was replaced; and the snag-boats *Eradicator* and *Henry M. Shreve* were constructed. All were of similar construction except the *Eradicator* which had a single hull with a double bow; construction costs averaged $25,000 each. Snag-boats constructed after Henry Shreve left the Engineer Department were patterned after the *Eradicator* because it had a lighter draft and could more readily work at the lowest water stages when snags were exposed. Captain Shreve also employed about eight small steamboats as auxiliaries to snagging operations and the other projects in his charge.[14]

Snag Removal Project

The clearance of snags from the western rivers was not exclusively accomplished by the snag-boats. Captain Shreve planned snagging operations in three phases: first, work crews with hand tools cut away all snags and overhanging trees in island chutes and on sand bars which might endanger navigation at high-water stages; second, the snag-boats removed larger snags from the main channels; third, the snag-boats and working crews returned at low water to remove snags which were newly exposed or newly deposited in the river channels. The project involved immense amounts of manual labor. For example, in October and November, 1830, Captain Shreve and his workmen removed snags from a two mile stretch of the Ohio just below the Louisville and Portland Canal. When sawed to pieces and stacked on the bank for burning, the snags made some 1200 cords of wood. Captain Shreve commonly employed as many as 600 men during working seasons on the Ohio and Mississippi rivers, and snagging projects were soon authorized by Congress for a number of other rivers — the Missouri, the Cumberland, the Arkansas, and the Red River of Louisiana. It was in removing the huge mass of tangled timbers, commonly called the "Great Raft,"



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Captain Henry M. Shreve clearing the great raft from Red River, 1833-1838

Painting by Lloyd Hawtome (American, 1924-)

which almost completely blocked navigation up the Red River, that Captain Shreve won his greatest laurels. The city of Shreveport, Louisiana, is named for the Captain.[15]

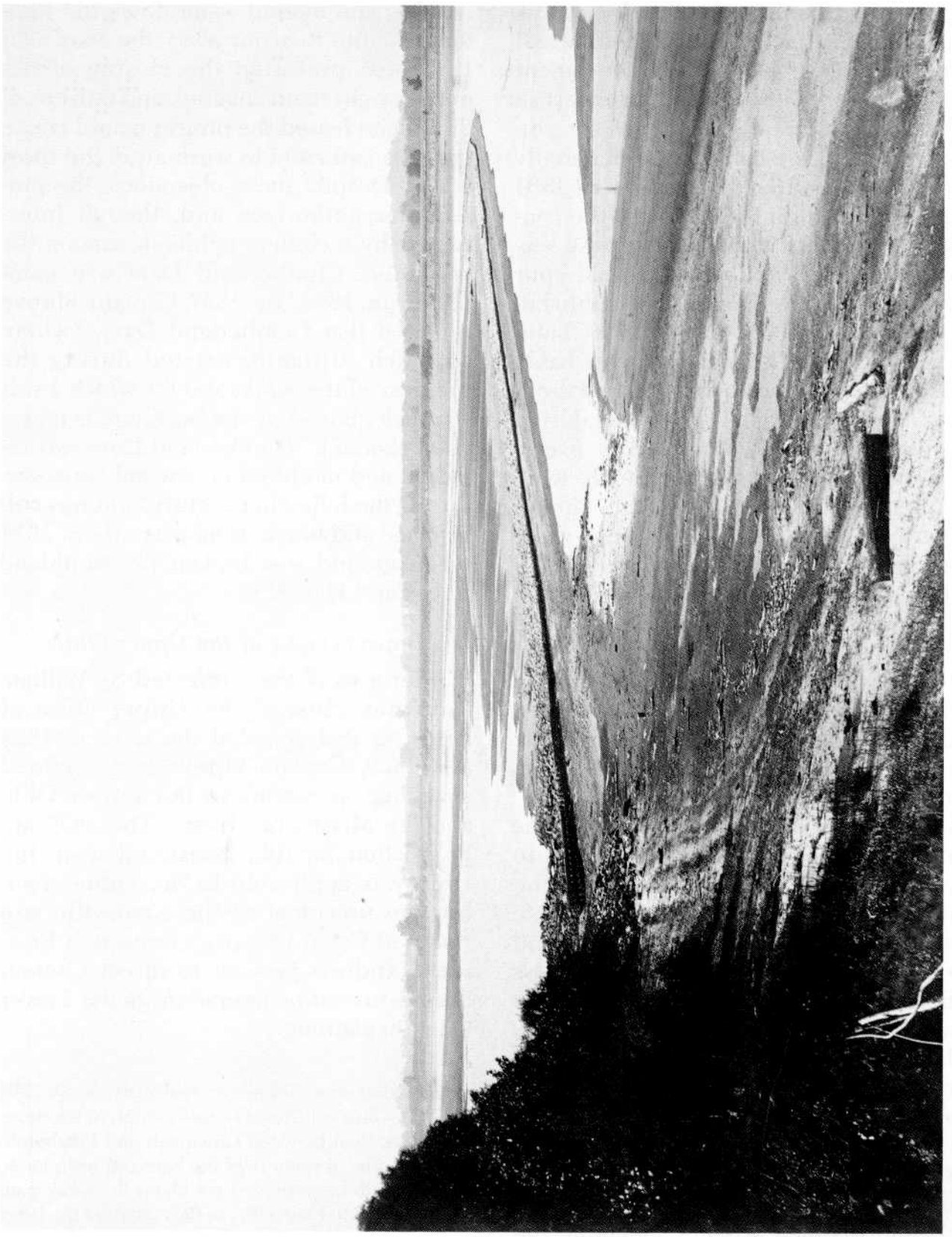
Captain Shreve believed the most important phase of his snagging operations was clearing the banks of the rivers of trees which might cave into the water and form new snags. Many rivermen opposed this operation, however, in the belief that the stumps would roll into the rivers as the banks caved and, because they would not be visible to pilots, would form more dangerous obstructions. Objections were so vigorous that clearing the banks was suspended in 1833; but after study of the problem the Office of the Chief Engineer agreed with Captain Shreve that the stumps would sink to the bottom of deeper parts of the channels and create few, if any, additional hazards to navigation.[16]

The benefits of the snag removal projects were evident within a short time after work was initiated. Snags were responsible for the great majority of steam boat losses prior to 1827; at the end of fiscal year 1832 Captain Shreve reported that only five steamboats had been lost on the Mississippi during the year, as a result of careless handling, and none at all were lost on the Ohio. Nor had he learned of any losses of flatboats or other watercraft on the Ohio, and he concluded that snags had become a relatively minor risk for steamboats, as compared with fires, boiler explosions, and collisions. By 1835 the number of flatboats insured at Louisville against loss had declined ninety percent from the number insured in 1829, though flatboat commerce had increased during that period; and the insurance companies had reduced premiums on insurance for flatboats by seventy-five percent. Insurance rates on steamboat cargoes also declined fifty percent between 1827 and 1835.[17]

Dike Construction on the Lower Ohio

The effects of the wooden-pile wingdam on the bar below Henderson, Kentucky, in the Ohio had proven that dike construction could be successfully utilized to increase navigable depths over similar obstructions. The stone rip-rap dam completed at the Grand Chain in 1830 confirmed the value of the method; and in 1831 Congress appropriated $150,000 for the construction of additional dikes on the Ohio, also providing that the projects be supervised by Captain Shreve under the inspection of an officer of the Corps of Engineers. Engineer officers had inspected the projects on the Ohio and Mississippi rivers at various times from 1827 to 1831, but after 1831 a single officer served as inspector.[18]

From 1831 to 1834, Captain Richard Delafield, Corps of Engineers, inspected the work of Captain Shreve, furnished technical assistance in dike project planning, and participated in joint surveys with Shreve of various water courses. Captain Delafield was in charge of construction of the National Road across Ohio and Indiana during the same period; he later served twice as Superintendent of West Point, became Chief of Engineers during the Civil War, and designed the castle insignia which have become the symbol of the Corps of Engineers. Lieutenant Alexander Bowman, Corps of Engineers, was inspecting officer from 1834 to 1839, with concurrent responsibility for military road construction in Arkansas. Lieutenant Bowman also served as Superintendent of West Point at a later date, and he became one of the earliest authorities on the use of concrete for construction in the United States.[19]



Ohio River — French Island Dike, 1892

Dike construction presented different engineering problems at each project site, requiring detailed hydraulic studies and careful planning before commencement of construction. The engineering expertise and mathematical abilities of the inspecting officers contributed materially to the success of the projects. From 1831 to 1835, Captain Shreve directed the construction of loose stone dikes across secondary channels and longitudinal spur dikes at five shoals on the Lower Ohio between the Falls and the Grand Chain. Stone was quarried near the river bank, transported in scows to the site, and dropped into place along a line laid out during previous surveys. Two spur dikes, over a mile and a half in aggregate length, were completed at French Island; two similar structures at Scuffletown Bars were three-quarters of a mile long; three dikes at Three Sister Islands totaled over a mile in length; and one at Three-Mile Island Bar was about a half mile long. None of these shoals had more than two foot of water over them before work was initiated and navigation was marginal at each; at completion of the projects, all had a minimum navigable depth of four feet.[20]

Cumberland Island, at the mouth of the Cumberland River, divided the Ohio River into two channels, or chutes. The main channel was down the right chute next to the Illinois bank, because a sand bar in the Kentucky Chute blocked access to Smithland, Kentucky, then an important commercial center and steamboat terminal where Cumberland and Ohio river packets exchanged freight. Downbound vessels took the right channel, circled the toe of Cumberland Island, and turned upstream to reach Smithland or enter the Cumberland. Captain Shreve and Captain Delafield planned a dam connecting the toe of Dog Island with the head of Cumberland Island, thus closing the right-hand channel and forcing water down the Kentucky Chute to scour away the sand bar. Rivermen protested the closing of the deeper right-hand channel, and citizens of Smithland feared the project would create currents sufficient to wash away the town wharf. Despite these objections, the project was authorized and, though interrupted by a cholera epidemic among the workmen, Cumberland Dam was completed in 1834. By 1837 Captain Shreve reported that Cumberland Dam, "where so much difficulty existed during the progress of the work, and for which I was so much abused by the boatmen, is now a good channel." Cumberland Dam was repaired and modified on several occasions during the following century, and was still in place and functioning properly in 1971 when ground was broken for Smithland Locks and Dam.[21]

Improvement of the Upper Ohio

After a work force directed by William Courtney cleared the Upper Ohio of snags, as it descended the river in 1828 and 1829, Captain Shreve had confined snagging operations to the Lower Ohio and the Mississippi rivers. The 1831 appropriation for dike construction on the Ohio was applicable to the entire river, but the president of the Louisville and Portland Canal Company requested President Andrew Jackson to direct Captain Shreve to confine operations to the Lower Ohio, explaining:

> The commerce and intercourse between the falls of the Ohio and New Orleans is nine to ten times greater, than between Cincinnati and Pittsburgh, the depths of water over the bars and low places, that are to be improved are about the same from Cincinnati to Louisville, as they are from the latter place to the mouth of the Ohio, the removal of a few of the most prominent obstructions below the

falls would permit boats to pass up to the Canal at all stages of water . . . .[22]

It appears that this argument prevailed, for dike construction was confined to the Lower Ohio until 1835 when Congress appropriated $50,000 for the improvement of the Upper Ohio. Congress also directed that the Upper Ohio project have its own supervising engineer; and the Chief Engineer appointed Lieutenant George Dutton, Corps of Engineers, as Superintendent of the Improvement of the Upper Ohio River on April 23, 1835. Lieutenant Dutton proceeded to Pittsburgh, acquired a copy of the 1819 survey of the Upper Ohio, and, in September, 1835, examined the river from Pittsburgh to Louisville. He found it much obstructed by snags, rocky shoals, and sand and gravel bars; and he reported that a specific minimum navigable depth could only be established by a lock and dam slackwater system, but considerable improvement could be accomplished by removing snags and rocks, damming secondary channels, and constructing spur dikes at shoals.[23]

Lieutenant Dutton put fourteen machine boats, keelboats, scows, and a steamboat to work on the Upper Ohio in 1836 and commenced construction of a dike at Brown's Island between Pittsburgh and Wheeling; the latter was the first permanent structure built by the Corps of Engineers on the Upper Ohio for the benefit of navigation. Lieutenant Dutton was reassigned at the end of the summer of 1836 to duties on the National Road, and on August 31, 1836, Lieutenant (later Captain) John Sanders took charge of the Upper Ohio project.[24]

Captain John Sanders was, his contemporaries thought, a remarkably original engineer. He invented a steam-powered pile driver and developed mathematical formulas for bearings, driving, and resistance of piles; he developed a mechanical cement mixer and instituted studies of the strength and properties of various cements; he was also one of the earliest advocates of the use of ironclad steamboats, or "floating batteries" as they were originally known. Sanders found the Upper Ohio project quite a challenge, enjoyed life in the Ohio Valley immensely, and while in charge of the project married the daughter of Congressman William Wilkins (Secretary of War, 1844-45) of Pittsburgh.[25]

Survey of the Upper Ohio

Captain Sanders concluded that rational improvement of the Upper Ohio could be accomplished only if more reliable information about the hydraulic regimen of the stream were available; therefore, he initiated, as he described it, "a survey of the river, comprising a complete hydrographical and topographical survey, giving the bars, channel, and shores; ascertaining the soundings and velocity of the current; and exhibiting every thing necessary for the most judicious location of the dams, and the formation of the best adapted project of improvements." He personally interviewed river pilots and spent uncounted hours wading the river with his survey parties; and his completed survey report constituted an important contribution to the science of fluvial hydraulics, while his maps of the Upper Ohio were not superceded until the twentieth century.[26]

His survey confirmed the fact that the Upper Ohio was considerably more shallow, had a greater slope, and had more rocky shoals than the lower river. He found that at extreme low water shoals on the Upper Ohio frequently had as little as sixteen inches of water over them; and old rivermen testified that there had been

even less in 1796 and 1819. While the survey was in progress, the lowest water of record occurred on the Upper Ohio in 1838, when as little as twelve inches of water was available on some shoals and steamboat navigation was suspended from July 20 to November 8. Captain Sanders reported the "inconvenience and loss arising from an interrupted navigation of the river has been felt throughout the Union. Large quantities of merchandise destined west, were detained for want of river transportation at Pittsburgh, Wheeling, and Portsmouth and the produce of the country at the points where grown. Travellers had to resort to an expensive land transportation, or await the rising of the river."[27]

River interests, merchants, and the Falls pilots urged Captain Sanders to take advantage of the extreme low water to remove some of the more dangerous rocks at the Falls of the Ohio; and, after obtaining the approval of the Chief Engineer, the Captain sent Captain John K. Dillingham, a snag-boat pilot who had supervising blasting at the Grand Chain in 1830, to the Falls to employ laborers and start blasting. Louisville rocked as Dillingham blasted day and night. He employed temporary labor, worked the crew of his snag-boat, and acquired the services of convicts from the Indiana State Prison to complete as much work as possible during low water. Rock was blasted out of the Indiana Chute and placed in low dams across secondary channels until the Ohio began to rise on November 7. At a cost of $1,255.34, Indiana Chute was blasted open to a minimum width of twenty-five feet; and Falls pilots estimated that at least twenty inches more water was available in the Chute when work ended. This emergency project would, Captain Sanders believed, free many watercraft from the "onerous tax" paid to the Louisville and Portland Canal Company.[28]

Operations on the Upper Ohio, 1835-1838

In addition to boulder and snag removal, Captain Sanders planned dikes at various shoals designed to increase the minimum navigable depth to thirty inches. There were at least twenty steamboats plying the Upper Ohio in 1835 which drew less than twenty-inches of water. Dike construction was commenced at twelve of the most obstructive shoals, at such sites as Duff's Bar, Petticoat Ripple, Dead Man's Island, Beaver Shoals, Captina Island, and Buffington Island. All were constructed of stone riprap along lines laid out by Captain Sanders. Their size may be illustrated by the dimensions of the dam which closed the back channel at Buffington Island, 215.5 miles below Pittsburgh. It was 2,260 feet long, had a base width of about fifty feet, and was topped off at a height of about six feet above low water.[29]

For the removal of snags and projecting rocks, Captain Sanders arranged the construction of five Bruce machine boats and organized five working parties of about sixty men each. These worked up and down the river as water stages permitted. In 1837 he also contracted at Louisville for the construction of a steam snag-boat at a cost of $17,800.05. The snag-boat, named the *Henry M. Shreve* after its inventor, was completed in June, 1837, and began work on the Upper Ohio in August. The *Shreve* later joined the Engineer fleet at work on the Lower Ohio and other waterways. From 1835 to 1839, the Corps of Engineers expended $180,000 for general channel clearance, $150,000 for dike construction, and $17,800.05 for a snag-boat in improving navigation on the Upper Ohio.[30]

Federal Waterways Policy, 1829-1841

Changes in federal waterways policy were in progress by 1839 which resulted in the temporary suspension of the projects for improving navigation on the Ohio River. Waterways improvement projects, commenced during the Adams-Clay era of economic nationalism, 1824-1829, had been continued during the administration of President Andrew Jackson, 1829-1837. Though President Jackson was to be remembered for his anti-internal improvements policies — Jackson once referred to internal improvements as "this corrupt, log-rolling system of legislation" — his military experience had made him a warm supporter of the Corps of Engineers and he approved of waterways improvement projects on those "great leading and navigable streams from the ocean, and passing through two or more states." President Jackson vetoed a few bills for waterways projects, notably one which would have funded a project on the Wabash River, but appropriations for the improvement of the Ohio were enacted during every year of his administration and almost seven million dollars were expended on waterways improvements during his administration.[31]

President Martin Van Buren, 1837-1841, like Jackson, disapproved of internal improvements at federal expense, and evidently included projects for waterways navigation in the internal improvement category. During his administration, appropriations for waterways projects ceased and a major reorganization of the Corps of Engineers was effected. The Topographical Engineers had been separated from the Corps of Engineers in 1831 and established as an independent Bureau of the War Department with its own Chief Engineer; and in 1838 the Van Buren administration transferred waterways improvement projects to the Topographical Bureau. The improvement of navigation on the inland rivers remained under the supervision of Topographical Engineers until the Civil War, when the two Engineer Corps were amalgamated.[32]

Improvement of Ohio River Suspended

The nation experienced its first major economic depression after the Panic of 1837, and federal expenditures were curtailed by the Van Buren administration as an economy measure. No appropriations for the improvement of navigation on the Ohio and Mississippi rivers were enacted by Congress from July 7, 1838, to August 23, 1842, and the projects in progress on the Ohio River, most only partially completed, were suspended.

Captain John Sanders requested an appropriation of $312,000, including $5,000 for additional work at the Falls of the Ohio, for the Upper Ohio River in 1839, but Congress took no action on the recommendation. The floating plant for the Upper Ohio project — the *Henry M. Shreve,* machine boats, scows, and a small steamboat — was tied up at Steubenville, Ohio, and in 1840 it was sold at public auction at great loss. Captain Sanders was ordered to New York City, where he participated in fortification construction around the harbor.[33]

The last inspection of the work of Captain Shreve on the Lower Ohio and other rivers was conducted by Captain Robert E. Lee, Corps of Engineers, in 1839. Captain Lee and Lieutenant Montgomery C. Meigs had visited Captain Shreve at Louisville in 1837. They were assigned responsibility for the improvement of the Upper Mississippi River and conferred with Shreve about engineering matters. Captain Lee later became commander of Confederate armies; Lieutenant Meigs

became Quartermaster General of the Union Army. Captain Shreve furnished the two Engineer officers with machine boats and a steamboat to inaugurate the improvement of the Upper Mississippi; and Captain Lee also contracted for the construction of a steamboat and stone scows at the New Albany shipyards. On a return trip in 1839, Captain Lee inspected the Lower Ohio project. He reported that Captain Shreve's riprap dams were functioning effectively and recommended that additional dikes be constructed at such sites as Wabash Island Bar, New Albany Bar, and Flint Island Bar, but no appropriations for this work, or for continuation of existing projects on the Ohio River were made in 1839.[34]

When available funds were exhausted, the snag-boats and other Engineer floating plant were collected at St. Louis for preservation under the care of Captain Shreve until 1841. The Van Buren administration paid the penalty for the national depression in 1840, when William H. Harrison and John Tyler, the Whig ticket, were elected. Captain Henry M. Shreve, a Jacksonian Democrat, was removed from the post of Superintendent of Western River Improvements on September 11, 1841, but it was forty years before the United States settled its account with the Captain. Shreve had taken a patent on the steam snag-boat in 1838, and in 1840 he requested payment for its use:

> I must beg leave respectfully to call the attention of the department to my claim for the invention of the snag-boat .... I see no reason why I should not be paid a fair compensation for the use of that machine by the Government; and therefore hope that some provisions will be made at the approaching session of Congress to do me justice, which is all I ask.[35]

When Congress again appropriated funds for waterways in 1842 and the Engineers returned the snag-boats to service, Captain Shreve sought a court injunction against their use without compensation for his patent, and extensive litigation and congressional investigation ensued. Colonel Stephen H. Long and Major George W. Hughes of the Topographical Engineers and Charles M. Keller, Examiner of Patents, all agreed that Captain Shreve was due some compensation for his invention, but there was disagreement over the amount which would be adequate. Shreve declined to accept $40,000 on several occasions, contending that his invention, by clearing the Red River of Louisiana of the Great Raft, had increased the value of western public lands by millions, and it had substantially lowered the costs of transporting troops and supplies to the frontiers. The question was not settled in Shreve's lifetime, but Congress eventually appropriated $50,000 in 1881 for payment to Shreve's estate.[36]

Captain Shreve made his farm near St. Louis his home after 1841 and invested heavily in the steamboat business. In his last years the old keelboatman and steamboat captain became, perhaps somewhat ironically, a proponent of railroads. Just before his death in 1851, he organized the Pacific Railroad Company which eventually became the Missouri Pacific Railroad.[37]

Summary

From 1827 through 1838, Congress made annual appropriations for clearing the Ohio and Mississippi river channels of snags and other obstructions. Manual labor, Bruce machine boats, and small steamboats were utilized for the work, but the rapid removal of the obstructions was facilitated by the development of the steam snag-boat. Benefits to waterborne commerce were substantial, as indicated

by the fifty and seventy-five percent reductions in insurance rates on waterways traffic not long after the project was initiated. Snags, which were the major cause of steamboat accidents prior to 1827, were reduced to a minor hazard in comparison with shipboard fires and operational accidents. But new snags were deposited in river channels after every high water, and the Army Engineers recognized that river clearance would necessarily be a continuing project if it were to be effective. Even in the deep slackwater pools on the Ohio and other rivers in 1975, occasional removal of obstructive snags was still necessary.

Separate appropriations for a project on the Upper Ohio River were enacted by Congress from 1835 to 1838, and under the direction of Captain John Sanders the upper river was cleared of its most hazardous obstructions. But on the Upper Ohio, as on the Lower, the major problem for waterborne commerce was not the hazards presented by snags, but the seasonal fluctuations of the river which at times brought practically all waterways traffic to a halt for several months of the year. The successful experiments of Major Long and Captain Shreve at Henderson and Grand Chain proved that economic methods for providing increased navigable depth at the shallowest shoals could be instituted; and in 1831 construction of a few stone dikes at selected shoals on the Lower Ohio was funded, followed by an appropriation for the construction of similar structures on the Upper Ohio in 1835. The survey of the Ohio River commenced by Captain Sanders in 1837 and the construction of stone dikes contributed materially to knowledge of the hydraulic regimen of the river and lengthened the navigable season somewhat for the light-draft vessels of the era. Stone riprap dams and dikes were constructed by the Louisville Engineer District and other Engineer Districts on the Ohio River until the slackwater lock and dam project was completed in 1929; some were still functioning in 1975, though rapidly disappearing as the deep slackwater pool navigation project progressed.

The burgeoning waterways commerce on the Ohio River during the 1830s necessitated swift and effectual measures to improve navigation, while limited knowledge of the principles of waterways engineering and limited funding presented great difficulties for the Corps of Engineers. The vigor of Captain Henry M. Shreve, the scientific acumen of Captain John Sanders, the expertise of various inspecting Engineer officers, and the herculean labors of the workmen met the immediate exigencies of the situation and improved navigation, insofar as meager funds permitted, in a manner adequate for the needs of the light-draft vessels of the era. Upon this experience and these accomplishments, the Corps of Engineers founded its continuing program of projects to benefit waterways navigation in the Ohio Valley and elsewhere.